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OPERATING EXPERIENCE SUMMARY

Office of Nuclear and Facility Safety

January 15 – January 31, 2000

Summary 2000-02

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EVENTS

1. WORKER INJURED BY FALLING DUCTWORK

On January 13, 2000, at Lawrence Livermore National Laboratory, a construction worker was injured when one end of a 19-ft.-long section of 42-inch intake ventilation duct broke free and swung downward, striking the worker. The duct was being installed on the roof of the National Ignition Facility. The worker was knocked down and complained of back pain. A co-worker called 911, and emergency personnel arrived to assist the injured worker. A temporary walkway was erected to move a stretcher to the area where the injured worker was lying. The worker was air lifted to a local hospital and admitted for possible back injury. Failure to adequately review work safety and ensure adequate egress when planning work can cause personnel injury and inhibit removal of potentially injured personnel. (ORPS Report OAK--LLNL-LLNL-2000-0003)

The investigators determined that the crew of three workers had secured one end of the 42-in. circular stainless steel duct on a temporary full-decked wooden platform and were lifting the other end with chains on a ratchet pulley device when the duct swung downward. The ratchet pulley device was braced by two 4x4 wooden planks. Investigators speculate that the 4x4 braces were not capable of supporting the weight of the duct, and one of the 4x4 braces cracked causing the failure. Investigators considered the falling duct a work planning issue, a flaw in the job design.

The injured worker was not directly underneath the falling duct. However, the duct swung to one side and hit the worker. The wooden full-decked platform was accessible by temporary scaffolding stairs. Several options were considered by paramedics to immobilize the worker who had an apparent back trauma. A temporary walkway was prepared before the paramedics arrived and they moved the worker to a section of partially-constructed roof with an opening, where a crane man-basket could be lowered to remove the injured worker from the building. The injured worker was lowered to the ground and transported by helicopter to a local hospital. Doctors determined that the injured worker sustained 2 fractured vertebrae. He was placed in a back brace, and released after 3½ days in the hospital, to convalesce at home up to several months.

Two committees have formed to review work safety practices and determine why two accidents occurred within 24 hours at the National Ignition Facility construction site. One committee will examine the two specific accidents including specific details regarding the cause of the back injury incident. Engineering safety systems prevented serious injury in the first accident. A worker was bending rebar, which suddenly broke. He lost his balance and fell. The tool he was using to bend the rebar flew up, causing a small wound on his face. Fall protection equipment held him suspended. A hard hat and safety glasses prevented serious injury. The worker received emergency room medical treatment and was released without restriction (ORPS Report OAK--LLNL-LLNL-2000-0002). The second committee will identify any common or systemic causes between the two accidents and identify and correct the root cause(s) of the accidents to prevent similar occurrences.

EH has reported loss of control of loads during hoisting and rigging operations in several Summaries. Some examples follow:

- Weekly Summary 99-17 described an April 22, 1999, at the Oak Ridge East Tennessee Technology Park, where BNFL Inc. senior journeyman sheet metal workers were injured while removing a 2,600-lb section of ventilation ductwork. A fork truck was supporting the free-hanging, 18-gage steel duct section when it fell to the floor. The workers had released the duct section from support rods when the load shifted forward and fell off the fork truck tines. As the ductwork fell, it struck the bucket of a manlift and moved it over several feet, forcibly jostling a worker in the manlift. An 80-lb piece of channel iron under the duct section fell vertically to the floor and tipped over, striking another worker in a different manlift on the front of his hard hat. Both workers were able to exit the work area to be treated by medical personnel. The worker who was in the manlift bucket experienced lower body stiffness in the hip area and the other worker required 10 stitches to close a forehead wound caused by the blow from falling channel iron. (ORPS Report ORO--BNFL-K33-1999-0004)

- Weekly Summary 98-26 reported two events involving personnel injuries that occurred during hoisting and rigging operations. At the Decommissioning Project, a subcontractor ironworker received multiple fractures to his leg when he tried to control a swinging bundle of structural steel beams being lifted by a crane. The load struck other structural steel components in the lay-down area, causing two pieces of steel to behave like scissors, pinching the right leg of the ironworker. At Lawrence Livermore National Laboratory a subcontractor steelworker was injured when his head was trapped between a steel truss beam an outrigger on a crane. He received lacerations to the temple area his aluminum hard hat.
  (ORPS reports OH-AB-RMI-RMIDP-1998--0003 and SAN- -LLNL-LLNL-1998-0034)

- Weekly Summary 98-01 reported that riggers at the Hanford Site were lowering a drum onto a trailer when the drum slipped free of its rigging and fell over. A rigger working on the trailer bed jumped away from the falling load, fell off the trailer, and sustained a head injury.
  (Report RL--PHMC-FSS-1997-0030)

These events illustrate the importance of observing safe hoisting and rigging practices. All personnel involved in hoisting and rigging should understand the following references.

- DOE-STD-1090-99, *Hoisting and Rigging*, section 3.2*, Operation Evaluation,* states that personnel must determine the consequences of a collision or an upset or of the dropping of a load. Section 3.3, *Lifting Fixtures*, governs the design, fabrication, maintenance, and control of special lifting fixtures and rigging accessories.

- DOE Office of Oversight publication *Independent Oversight Special Study of Hoisting and Rigging Incidents Within the Department of Energy*, October 1996, analyzes DOE hoisting and rigging incidents between October 1, 1993, and March 31, 1996. This special study can be found at: http://tis.eh.doe.gov/oversight/reviews/hoist_rig.html

KEYWORDS: Injury, falling object, hoisting, rigging

FUNCTIONAL AREAS: Work Planning, Emergency Aid, Construction

2. DISCOVERY OF POTENTIAL UNSTABLE CHEMICAL

On December 30, 1999, at Oak Ridge National Laboratory (ORNL), safety personnel at the Life Sciences Division discovered out-of-date Cellulose Nitrate solution, 12 weight percent normal, which was improperly stored. The ORNL Laboratory Waste Services incident commander recognized the hazard, restricted all access to the room where the chemical was found including the immediate area, and requested removal/disposal of the chemical as soon as possible. Improper storage of flammable or explosive chemicals can cause property damage and personnel injury. (ORPS Report ORO--ORNL-X10LIFESCI-1999-0004)

Investigators determined that to properly store highly flammable volatile nitrocellulose, it must be completely submerged under 2-Propanol-2-14C, isopropyl alcohol at greater than 25 weight percent. The nitrocellulose was stored under less than 50 milliliters of 2-Propanol solution when at least 400 milliliters was required for storage stability. Investigators also determined that cellulose nitrate is an oxidizing chemical that is flammable and explosive when stored dry. It is an irritant to eyes, respiratory system and skin. Exposure to cellulose nitrate can result in serious damage to the eyes, as well as damage to nerves and kidneys if vapors are inhaled.

The Life Sciences Division reported a similar occurrence on March 9, 1998, which was classified as a near miss occurrence. Investigators determined that contract workers in the Y-12 Waste Management Organization discovered a small container of 2,4,6-trinitrochlorobenzene stored in a flammable solvent cabinet in Building 9220. 2,4,6-trinitrochlorobenzene was recognized by the Waste Management Organization as potentially hazardous. It was not listed in the building chemical inventory, and there was no Material Safety Data Sheet on file with the Life Sciences Division. Upon further investigation, the chemical was classified as having a Department of Transportation hazardous classification of 1.1 (“potentially explosive”).
(ORPS Report ORO-ORNL-X10LIFESCI-1998-0002)

The Life Sciences Division also reported a precursor event to the cellulose nitrate discovery, on July 22, 1999. An employee of the Oak Ridge environmental management prime contractor reported to the Y-12 Site Plant Shift Superintendent the existence of a “bubbling container” of an “unknown quantity” of dichlorodimethylsilane in a former research facility in the ORNL Biology Complex. The Plant Shift Superintendent declared an Alert and ordered the evacuation of the abandoned building and nearby buildings because of the uncertain health risks. The dichlorodimethylsilane was in a 100-milliliter bottle that appeared to be “sweating” and its top bulging. The compliance specialists determined from the Material Safety Data Sheet that this material was flammable, corrosive, and moderately toxic, but significantly less than the Reportable Quantity under the Comprehensive Environmental Response Compensation and Liability Act. The compliance specialists notified Life Sciences Division management who were formulating a plan for proper handling prior to disposal before the Alert was declared. Attention to the potential serious consequences to co-located workers from exposure to the dichlorodimethylsilane event contributed to the discovery of nitrocellulose six months later.
(ORPS Report ORO-ORNL-X10LIFESCI-1999-0002)

KEYWORDS: Chemical, hazardous, flammable, explosive

FUNCTIONAL AREAS: Administrative Controls

3. RADIOACTIVE RELEASE DURING SALTWELL PUMPING

On January 6, 2000, at the Hanford River Protection Site, Saltwell operators discovered liquid leaking from an electrical junction box on the S-103 pump pit during a transfer operation. The saltwell was immediately shut down and the affected area at the S tank farm saltwells immediately isolated. Health physics technicians classified the affected area surrounding the tank farm as a high radiation area and the area was roped off. Four workers had Cs 137 contamination on personal clothing with readings below reportable levels. Two had minor internal contamination. Leakage from a transfer pipe during Tank Farm saltwell pumping operations can result in high level radioactive contamination to physical assets and workers in the affected area. (ORPS Report RP--CHG-TANKFARM-2000-0002)

Investigators determined that 2 to 5 gallons of liquid containing radioactive fission products leaked from a single-walled direct buried transfer pipe that contained heat-traced wiring. The liquid leaked from the pipe through the heat-trace wiring conduit, to the point of least resistance at the bottom of an electrical junction box on the pump pit. The leaking material was not under pressure and was not considered a "spray leak." Investigation determined that the spill contained approximately 8 curies of Cs-137 and other mixed fission products such as Strontium. A health physics technician with a Geiger counter determined a dose rate of 10 Rads per hour (open window) and 3.5 Rads per hour (closed window) at 6 in. from the leak area. He posted the area with caution tape and installed high radiation area signs. Access to the S Farm complex was restricted.

The Investigators also determined that a health physics technician surveyed three operators and an operating engineer and found low level contamination on their personnel protective equipment and work equipment. The contamination levels on the personal clothing and equipment were all less than reportable. No face or skin contamination was found and the operators were sent for whole body counting. Investigators determined that two individuals had internal contamination estimated at 2 to 4 nanocuries of Cs-137 and Sr-90. Dose results will be calculated and added to the workers' annual exposure history.

Recovery actions were initiated to decontaminate the leak area by removing the contaminated soil and placing it in barrels staged at the facility. Evaluations are being conducted to estimate the release and determine the exact leak location, and any significant changes will be reported in future articles.

KEYWORDS: Contamination, uptake

FUNCTIONAL AREAS: Radioactive Release

4. COMMON MODE FAILURE CAUSES LOSS OF HOT OFF-GAS VACUUM INDICATION

On January 10, 2000, at the Oak Ridge National Laboratory, two hot off-gas system vacuum indicators transmitted lower-than-normal readings to the High Flux Isotope Reactor control room triggering low vacuum alarms. When a roving operator investigated the potential common mode failure he discovered that both vacuum indicators had readings of 0 inches H_2O when a normal reading would have been 54 inches H_2O. The operator reported that the hot off-gas fans were operating correctly; however, there was no

vacuum indication. There were no injuries and there was no equipment damage associated with this event. Instrumentation or equipment that relies on a single power source is susceptible to common mode failure. (ORPS Report ORO--ORNL-X10HFIR-2000-0001)

The hot off-gas system removes non-condensable gases from the High Flux Isotope Reactor's primary cooling system. Investigators traced vacuum indicator power to a tripped ground fault circuit interrupter. When they reset the ground fault circuit interrupter, power was restored to the vacuum indicators. Investigators determined that both vacuum indicators failed when their common power source tripped. They determined that independent vacuum readings were required for system verification and that in the event of a power source failure at least one vacuum indicator should continue to function. Facility management held a critique of this event and determined that a second power source should be established to ensure that one vacuum indicator continues to operate when the power source for the other vacuum indicator is tripped.

KEYWORDS: common mode failure, power source

FUNCTIONAL AREAS: Operations, Instrument & Calibration

5. BACKHOE OPERATOR EXPOSES 120-VOLT ENERGIZED CABLE

On January 5, 2000, at the Savannah River Site, a backhoe operator exposed an energized 120-volt electrical line while digging a trench to install electrical cables. The backhoe operator instructed a laborer to verify the cut line by removing the loose dirt in the trench with a shovel. When the laborer's shovel contacted the cut line, a visible electric arc occurred. The backhoe operator informed facility management who suspended work in the area, identified the breached electrical system, issued a lockout, and held a critique of the occurrence. There were no injuries associated with this event. Contacting exposed underground electrical cables can cause serious injury. (ORPS Report SR--WSRC-ERF-2000-0001)

Investigators determined that before trench digging had begun, a survey crew identified underground cables using facility drawings. They determined that in addition to doing research the survey crew used ground-penetrating radar to identify 8 underground interferences that were in excess of 100 feet of the cut line. Investigators determined that when the backhoe operator initiated digging he exposed the identifying ribbon and cable for an injection well instrumentation line and failed to follow site procedures which state that:

- work is to be stopped
- management is to be notified
- lockout is to be issued
- facility drawings are to be identified and reviewed

The event critique identified the following lessons learned.

- Personnel involved with trenching work need to do a thorough research of facility drawings and documentation to ensure that all available underground interferences are identified.
- Personnel must follow site procedures to de-energize electrical systems
- Personnel should be familiar with what constitutes a "change in work scope."

EH has reported on similar events. Following are some examples:

- On October 30, 1997, construction workers at the Monticello Remedial Action Project repository severed a temporary, partially buried, energized 480-volt cable with a front-end loader. They severed the cable while moving a pile of sand that had been dumped in the area above the cable. The cable connected a portable diesel-driven generator, rated at 141 kilowatts, to a power distribution panel located next to a decontamination pad at the repository. Investigators reported that construction personnel originally installed the cable on top of the ground. However, because of foot and vehicular traffic over a period of several months, the cable became buried to a depth of 2 to 3 inches. Site personnel immediately stopped all work until an investigation was completed and initial corrective actions implemented. There were no personnel injuries and no equipment damage other than the severed cable. (ORPS Report ALO--MCTC-GJPOTAR-1997-0014)
- On August 5, 1996, at the Rocky Flats Environmental Technology Site, a subcontractor severed an energized 200-volt cable with an auger while boring holes for the installation of a barrier around an emergency diesel generator fuel tank. The cable supplied power for external lighting at an outer guard post. The subcontractor was not injured because he was riding in a trackhoe and was not grounded. Had he been grounded when he hit the cable, he could have received an electric shock and been severely injured. (ORPS Report RFO-KHLL-UTILITIES-1996-0027)

KEYWORDS: electrical cables, underground cables, trench digging

FUNCTIONAL AREAS: Industrial Safety

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